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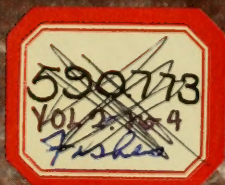
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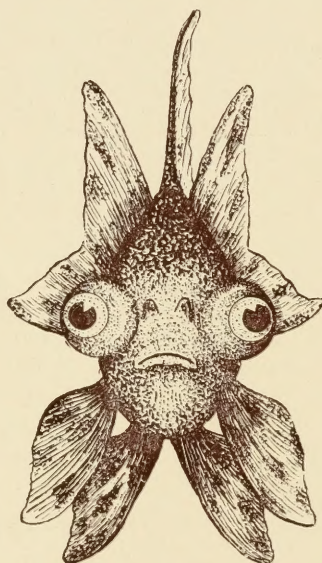
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THE AQUARIUM

VOLUME II

SEPTEMBER, 1913

NUMBER 4

Aquarium Heating Methods

By WM. T. INNES, Jr., Philadelphia

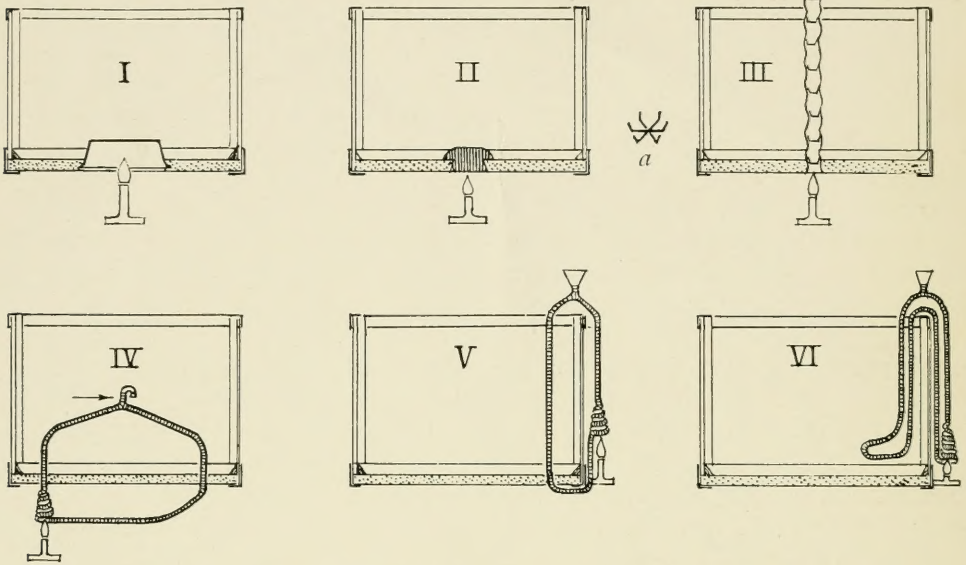
As there is every evidence of a general awakening along the lines of tropical aquarium keeping, it would seem to be of much practical value at this time to arrive at a satisfactory method of heating different styles of aquaria.

I have experimented in a careless kind of way for about two years, but, realizing that in the long run it will pay to get the proposition down to an exact basis, I have made a series of experiments in order to obtain comparative results by the different methods which experience has taught me to be the most valuable. Every method proposed in this article has its own particular good points and is the most suitable under certain circumstances. Where different methods may be employed at the selection of the aquarist, I will merely give the results and efficiency table so that he may choose for himself.

All systems to which I shall refer divide themselves into direct heating and the water-circulating system.

One of the most useful plans belongs to the latter class. It is illustrated by Fig. VI. This is an independent hot water system, run on exactly the same principles as a hot water system in a house. The tubing is composed of lead pipe 3/16 inch diameter inside, by 5/16 inch outside. In order to construct a system of this type, the following utensils are desirable, but not absolutely necessary: A small Bunsen burner; a soldering iron; thin wire solder; a small

sheet of zinc; soldering flux and a piece of brass tubing, 3/16 inch outside diameter with very thin walls. Take a piece of wood about an inch in thickness and several inches long and whittle one end down to a cone a little sharper than a 45 degree angle; twist the tubing around this to make a coil as shown in the illustration, about three turns are sufficient. In making the last turn on the coil—the small one—see that it does not take too sharp an angle and flatten the pipe so as to impede the circulation. By first packing the pipe with perfectly dry sand and temporarily closing the ends there will be no risk of flattening pipe. The sand can be shaken out after the bending is done. Now bend the pipe into its proper shape so that it will form a "U" on the inside and on the outside of the aquarium. The idea is that this system merely hangs on the top edge of the aquarium; the side which remains in the water should be made a little longer than will actually reach to the bottom, as it is desirable to spread the lower end out somewhat horizontally. Having bent the pipe into approximately the correct position, the next step is to join the two ends. If you have secured the brass tubing referred to, take a piece about three-quarters of an inch long and insert each end of it in the open ends of the lead pipe. For this purpose, spread the lead pipe very slightly. Now apply the solder flux to the exposed portion of brass tube and pipe, and hold the joint over the Bunsen flame. Apply the solder to the



The dotted space in the bases represents concrete or any other base.
The space above is sand or pebbles.

brass, and as soon as it is well melted, quickly push the ends of the lead pipe together. This will enclose the brass tube and make a perfect joint. If you cannot obtain the brass tubing, the ends of the lead pipe may be cut clean and joined with a piece of close-fitting rubber tubing on the outside. If the rubber tubing joint is used, see that it is in the section under the water. It lasts better there. We now have a closed piece of pipe, but all hot water systems need a method of allowing for the expansion of water and for replacing the water which is vaporized by the heat; also the vapor itself has to be disposed of. For this purpose, an open funnel is soldered into the pipe at the highest point on the turn where it goes into the aquarium after leaving the flame. Drill a hole at this point. It can easily be done with a pen-knife and the sides made straight by running a nail or other implement around the hole a few times. Make the hole as large as the inside diameter of number of positions so as to get the

water in all parts. After it is once filled the pipe. Take the sheet zinc and form it into a funnel about two inches high; solder this funnel together on the seam, then wire it into position on the lead pipe and solder it fast to same. The wiring is only put on temporarily in order to hold it in place while soldering.

The system is now ready to fill, but this is not as easily done as might at first be imagined. Fill the funnel with water, get a fountain-pen dropper, place it in the bottom of the funnel as far as possible and pinch the bulb repeatedly until all the water in the funnel is forced into the tube. Keep this up as long as any air can be sucked into the dropper while there is water in the funnel. When you can get no more air into the dropper, your system is probably full; now put your flame under the coil. If the water in the funnel becomes violently agitated, it shows that the water is boiling and that your system is not full. Sometimes it may be necessary to take it off the aquarium and hold it in a

it will remain so as long as water is kept in the funnel. Whenever bubbles are vaporized by the heat they pass into the funnel, and a corresponding amount of water is drawn back into the system.

This method of heating, while not the most efficient, is probably the most convenient of all, as it may be attached to any aquarium without disturbing its arrangements and may be discarded or removed to another aquarium in a few moments. Some little increased efficiency is added to this system by wrapping the warm part of the lead pipe, where it has not yet reached the water, in tape, or preferably incasing it in asbestos. When the pipe first enters the water it should be slightly protected so as not to come in contact with the fish. This may not be absolutely necessary, but it is a good precaution. For this purpose I have used a fine gauze rustless wire, but I find it more satisfactory to wrap it with a few thicknesses of tape and then saturate the tape with melted paraffine. If this is carried down about four or five inches below the surface of the water it will be sufficient to have the heat gradually diffused in the water. In order to avoid evaporation in the funnel, it is desirable to place a small piece of glass over it. If the water is exhausted from funnel the rest of the water in the system will quickly boil, owing to lack of circulation, and the next thing to happen will be the melting of the lead pipe. It might be mentioned that another way to tell whether you have established circulation is to touch the pipe just before it enters the water of the aquarium; if it is warm, your circulation is working. Also the water, just before reaching the coil, should be cold.

Exactly the same principle, with a considerable degree of efficiency added, is shown in Fig. V. In this case the heated pipe is carried over the aquarium, but the return pipe comes back through the bottom, thus avoiding the necessity of lifting the chilled water. It is obvious, of course, that this system is practically a part of the aquarium and cannot be removed without taking the whole aquarium down. Its advantage is increased efficiency, and that it only requires the aquarium to be raised perhaps one-half inch above its original level.

Fig. IV shows the latest development in the hot water system and is, I believe, the best of this type. Its efficiency far exceeds either of the others and in the matter of convenience and safety, it is infinitely superior, as it requires no attention after once being filled and the risk of melting the lead pipe is absolutely eliminated. This is owing to the invention shown at the top of the pipe in the illustration. This arrangement takes care of bubbles caused by vaporization, automatically refills the system and makes impossible any circulation of water between the closed system and the water of the aquarium, as well as being very inconspicuous. This is accomplished by an inverted hook at the top of the pipe. In the process of heating the water a small amount of vapor rises in the pipe and as soon as enough has collected to be on the level of the outlet (see arrow point in illustration) a bubble will be forced out and a corresponding amount of water drawn in, leaving a bubble still remain in the very top of the hook which performs the duty of separating the inside and the outside waters. I had this part of the system made of glass in order to see the



exact action of the bubbles, and I can say that it works to absolute perfection. By the movement of particles of dirt within the pipes one can see the speed and movements of the water, and after long watching, I never saw a particle of the waters interchange. To have the water from the heated system enter the aquarium would be undesirable, as this water has had practically all the oxygen driven out of it by the action of the heat. Furthermore, if the aquarium water were allowed to freely enter the system, there would no doubt, from time to time, be particles go into the pipe which would clog it up. The hook is made separate from the rest of the piping and is attached by a rubber hose of the same size. This makes the hook detachable so that the system can be readily filled.

Experiments on direct heating have been conducted in four ways. The first is by use of an inverted pan in the centre of the aquarium, a hole having been cut in the bottom of the aquarium the size of the pan, in order to allow the heat to be applied to the inside of the pan. There are several ways of cutting a hole and securing the pan. Probably the simplest is to make a new base for the aquarium out of an equal mixture of sand and cement, setting the pan in at the desired height. I use a small enamel milk pan about four inches across and one and one-half inches deep. If an aquarium has a thin slate bottom a series of holes may be drilled in the form of a circle. This method of heating has the advantages of being extremely efficient, requiring no attention and having the heating surface well above the sand. This allows free circulation of water over the heating surface and prevents the roots of the plants from interfering with the heating.

Another direct method (see Fig. II) through the bottom of the aquarium consists in cutting a hole of about one inch in diameter in the bottom and pouring either tin or lead into the hole. The lead should be allowed to spread a little at the top so as to make larger contact with the water. The flame may be applied directly to the underside of the block of metal. It is advisable to put a few pebbles over the upper side so as to avoid the risk of having the fish come in direct contact with the warm metal. I would personally have supposed this method to be undesirable as even with the pebbles over the heated spot there must be quite a great deal of local heat in a small place through which the fish swim. This would seem to be undesirable, but I have seen a large aquarium, containing many kinds of fish, apparently enjoying the best of health, which was heated in this manner. The illustration shows the metal in slightly enlarged proportions in order to make it clear.

If one has an aquarium with a metal bottom, there is no reason why the heat should not be applied directly to it. A few pebbles over the hottest part would be desirable and if one wished to prevent the roots of the plants from encroaching over this spot, it could be done by the use of a zinc ring about the width of the depth of the sand (one to two inches) and perhaps four inches in diameter.

Many aquaria have been built with a drain pipe of about one inch diameter. This can be utilized very nicely for direct heating (see Fig. III). In this experiment I have used what is called "Rope Brass Pipe." It is slightly corrugated and therefore adds a little efficiency. Any brass pipe, however, to



be used in an aquarium, should be first nickel plated. I found that by inserting in the brass tube a large number of "U"-shaped pieces of copper wire I got a great deal more heat, the idea being that as the heat from the flame passes through the pipe, much of it is absorbed by the copper wire and transmitted direct to the pipe. At the top of Fig. III is shown three of these pieces of copper wire crossed (a). It is a good plan to cross several of them in this way before forcing them into the tube. Push them in with a round stick which has a flat end and mark on the stick each time how far down the wires have gone and let the next come a little higher. The illustration shows the wires in place. In this way a great many may be inserted. The more the better.

If one has electricity in the house, a very cheap and satisfactory way of heating an aquarium is by having an electric light directly in the water. The electricity can be carried through a small lead cable, made especially for marine work, and the light bulb set in a porcelain socket without any key. If the light is now held in an inverted position and sealing wax melted around the opening where the socket is screwed in, it will be found to be quite waterproof. The Bunsen burner will come in handy for this. By this method I keep a 60-gallon aquarium heated to a temperature of 72 degrees in an atmosphere of from 55 to 60 degrees, using a 32 c. p. carbon filament lamp with a frosted globe.

For the heating of the systems described I have used a miniature Bunsen burner. They may be obtained of dental or jeweler's supply houses. It is sometimes difficult to get these burners so that they make a blue flame when turn-

ed down low. It is very important that the flame be blue at all times. This difficulty has been overcome by hammering the gas outlet in the burner smaller so as to require practically the full pressure from the gas main in order to obtain a large enough flame. It seems that in order to secure a proper Bunsen flame, the gas needs to be discharged under a fair degree of pressure in order to mix well with the air necessary to make complete combustion.

An extremely good small oil lamp can be had at the larger stores selling lamps. It is called "A Glow Lamp," and uses very little oil. It requires attention about every three or four days. The principle is somewhat different from the ordinary lamp; it burns vapor of kerosene and makes quite a hot, small flame.

The following statement of results obtained with the different heating methods herein described, will no doubt be of interest to those contemplating the installation of a heating outfit for any aquarium.

For ordinary heating, a Bunsen flame from one-quarter to one-half inch is ample. These tests were made with a three-quarter inch flame in order to get maximum results. It might be added, that all of these systems were installed in a single aquarium, built for this experimental work in order that the comparative tests should be made, as far as possible, under identical conditions.

The tests occupied about twelve hours each, and the capacity of the aquarium is $4\frac{1}{2}$ gallons. They were made with a glass cover on the aquarium. System number one gave a maximum rise in temperature above that of the surrounding air of 28 degrees, Fahrenheit; system number two, 31 degrees; number three (with copper wires inserted), 27 degrees;



number three (without copper wires inserted), 19 degrees; number four, 30 degrees; number five, 18 degrees; and number six, 16 degrees.

Two tests were made with no cover on the aquarium. This brought the temperature down three or four degrees.

Tests on numbers one and two with a half inch of sand over the heating surfaces showed the efficiency was lowered about two degrees.

For the best results, the flame must be set in the proper position. This position varies somewhat with the different systems. In number two (the metal disc of lead) the tip of gas flame should touch the metal. Oil flame a trifle lower down. For number one (the inverted pan) and flame should be about one-half inch below heating surface of pan. With the heating tube (Fig. III) the flame ought to be about half in the opening and half below. The three different coil systems produce best results with center of flame directly below the pipe on its second turn, and high enough up so as to nearly touch, or touch very lightly, the pipe on first turn. This, then, is not directly in the center of the coil. In this way the heat strikes vigorously against three points before it finally escapes through top of spiral. If much of the flame comes in contact with the metal, it interferes with perfect combustion and results in the unpleasant smell frequently noted where gas heating is used.

Water Hyacinths

By HARRY PETERS, Philadelphia.

In the Fall water hyacinths are a glut on the market. Although all goldfish breeders are anxious to have them in large quantities in the Spring it is impossible with ordinary facilities to carry

over more than a few, and these degenerate very much in size. Also those which can be purchased in the Spring are apt to be small. By proper treatment, these small plants can be brought up in size and multiplied in numbers so as to greatly increase the stock of spawning plants at the time they are needed.

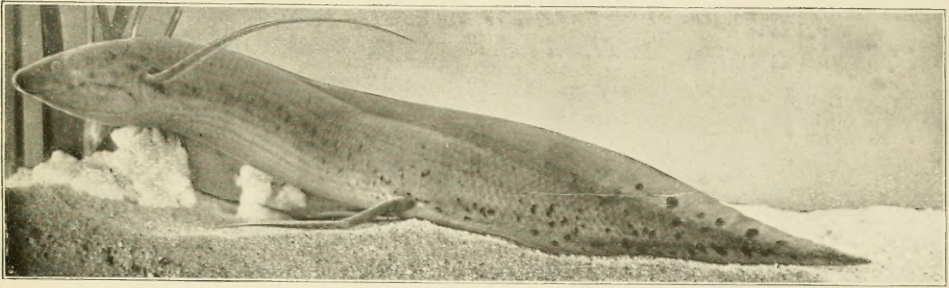
My plan is to start in early February. I use a wooden tub, place a 2-inch layer of fresh horse manure in the bottom, cover it with 3 or 4 inches of sand and then put in water so as to cover the sand to a depth of about 5 inches, so that the longer roots may be inserted in the sand. The tub should be kept in a fairly warm place and where it will receive as much light as possible. In three weeks the roots have doubled in length and new plants have budded out. If kept in the tub the plants will produce a continuous bloom all Summer, if the older plants are occasionally removed to make room for the new ones, for it is on the younger plants that the blossoms principally occur.

A List of Aquarium Fish and the Minimum Temperatures to Maintain Them in Perfect Health

(After K. Stansch.)

By WM. KOPP, Chicago.

- 1.—Family of *Centrarchide*, or Sunfishes. 12° C—50° F
- 2.—*Makropodus* Species, *Trichogaster lalius*. 16° C—61° F
- 3.—*Trichogaster Fasciatus*, *Osphromenus*,
Anabas, *Betta*, *Ctenops*. 20° C—68° F
- 4.—Family *Paciliide*:
Girardinus, *Gambusia*, *Jenynsia*. 15° C—59° F
Pacilia, *Mollitenesia*. 20° C—68° F
Fundulus Pallidus, *F. Chrysostius*. 18° C—65° F
West African *Fundulus* Species. 22° C—71° F
Cyprinodon, *Kribia*, *Cynolebias*. 20° C—68° F
Haplochromis. 20° C—68° F
- 5.—*Barbels*, *Danio*, *Capoeta*. 18° C—65° F
- 6.—*Pyrhulius*, *Pseudocorynopoma*, *Tetragonopterus*. 20° C—68° F
- 7.—Japanese Goldfish. 16° C—61° F
Common Goldfish. 12° C—50° F
- 8.—*Cichlide*:
Chanchito. 16° C—61° F
Geophagus, *Paratilapia*, *Tiapia*, *Cichlasoma*, *Neotroplus*. 18° C—65° F
Hemichromis, *Acara*, *Heterogramma*. 20° C—68° F
- 9.—Family *Siluride* (Catfish):
Callichthys. 16° C—61° F
Pimelodus, *Otocinclus Flexilis*. 22° C—71° F



LUNG FISH, *PROTOPTERUS ANNECTENS*
Photo by courtesy of Technical World

The Lung Fish

A wonderful fish that can live out of water for at least six months is the latest scientific curiosity to arrive in New York. It came from Africa. The specimen is popularly known as a "lung fish," because when out of water it inhales air as if it were a land-living animal, though when in the water it breathes through gills. The ability to breathe out of water preserves the life of the lung fish, when caught in the mud of a dried-up stream during the summer drought, until the stream fills up again.

The fish was received in a dormant condition, coiled up in a cocoon, deeply sunken in a clod of earth which had been dug from a dried-up river bottom. To release the fish from its case, the mass of mud was placed in tepid water to soften the wall of the capsule, which then became soft enough to remove a part of it, when the fish emerged alive. It is claimed that this species of fish has survived from a very ancient period of time and belongs to the earliest known species of land-living animals that form the connecting link between the true fish family and four-footed animals.

Aquarium Exhibitions

During the latter part of September and the first of October, two notable exhibits of fishes, aquaria and accessor-

ies will take place in Brooklyn and New York. The Brooklyn exhibit is to be held at the store of Abraham & Strauss, Fulton St., Brooklyn, September 22nd to September 27th, inclusive; and the New York show, to be held at the American Museum of Natural History, is announced for October 6th to 12th, inclusive. In both exhibitions a large variety of fishes are to be displayed, comprizing goldfish varieties, tropical and native fishes. Each of these main classes are arranged in several subclasses and cover practically all the fishes owned by American aquarists. Prizes are to be awarded for the best individual specimens in the several classes, for the largest and for the rarest collections in each of the main classes.

These two shows will bring out the best specimens in the East and should furnish a very lively competition, as there is much good stock in both cities. Those who live in the vicinity of New York and Brooklyn should not miss this opportunity to see these exhibitions as there will be much to see and learn.

The study of Nature is an intercourse with the highest mind. You should never trifle with Nature. At the lowest her works are the works of the highest powers, the highest something in whatever way we may look at it.—Louis Agassiz.



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VOL. II SEPTEMBER, 1913 No. 4

It is with deep regret and with a feeling of heavy loss that we have to announce the sudden and unlooked for resignation of our editor, Mr. W. A. Poyser, who on account of business matters had to relinquish his work on THE AQUARIUM. Those who personally knew Mr. Poyser and his work, readily realized his fitness for editing a publication relating to aquatic life; and those who knew him only as "The Editor" had placed before them each month in the form of THE AQUARIUM, tangible evidence of his ability. Mr. Poyser's long years of study in the realm of nature and his practical experience as an aquarist and his extensive readings gave him a fund of knowledge peculiarly fitting him for the dissemination of nature lore and especially facts of interest to aquarists. His place will be a most

difficult one to fill, but it is to be hoped that THE AQUARIUM will not long be without a "regular" editor. Until satisfactory arrangements can be made the management will endeavor to follow as closely as possible Mr. Poyser's ideas and publish the journal punctually. In the meantime we beg the indulgence of the readers until matters have again been satisfactorily settled. The credit of this issue is due to Mr. W. S. Hilpert of Chicago.

There is a side to the work of THE AQUARIUM magazine which does not receive much attention from the average reader. On close analysis, it is perhaps, as important as any, viz., the means by which the magazine exists. This paper is purely an amateur venture in the sense that no one of the staff concerned in its making receives money for his services. We give our time gladly in an endeavor to make the magazine the success it deserves. The measure of success is, in a large way, dependent upon the interest which you, the readers, evince. If you knew the amount of work necessary to place the magazine before you, we would have the sympathy of all. But we cannot exist on sympathy alone, nor is it desired, except in a friendly and courteous sense. Sympathy will not pay the printer and the plate-maker. What we need is co-operation of reader and advertiser. That more than any one thing will bring us success and **that is your part.**

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unless you do. Buy your supplies from an advertiser and compliment him on his foresight in putting his name where the aquarists can read about what he has for sale. If you purchase from a man who is not an advertiser, urge on him the advisability of using this paper, your paper, for the promotion of his business.

Thermometers

By FRED G. ORSINGER, Chicago.

Since foreign contemporaries use and quote other than the Fahrenheit thermometer, so generally used by our members, a short discussion of the various systems used was considered of interest.

Thermal or Heating value is that property by virtue of which a body has for absorbing or giving off heat.

Thermometer — An instrument for measuring temperatures, but very often supposed to be a heat measure. This latter is, however, erroneous, as it is in no sense a measure of heat, but gives simply a relative comparison as to the degree of heat in the body or fluid measured; that is, a thermometer registering 175 degrees in one body, while in another a thermometer registers 50 degrees, indicates that one body is 125 degrees warmer than is the other.

The Fahrenheit thermometer was introduced by Gabriel Daniel Fahrenheit, in 1724. It is used in America and Great Britain and the British Colonies. The number 0 degrees or zero on the scale corresponds to the lowest degree of cold that could be artificially produced when the thermometer was originally introduced.

The freezing point of water is taken at 32 degrees above zero, and the temperature of pure boiling water at 212 degrees. In both cases the measurement is recorded under the ordinary atmos-

pheric pressure of 14.7 pounds per square inch.

Between 32 and 212 degrees there are 180 degrees, which are usually spaced into 1-degree intervals.

The Centigrade thermometer, which was designed by Anders Celsius, a Swedish astronomer in 1742, and in Germany is known as the "Celsius" and also "Centigrade" and indicated as "C" is used in Europe and in scientific work generally. 0 degrees or zero corresponds to the freezing point, or melting ice (which is marked 32 on the Fahrenheit scale) and 100 degrees to boiling water. From the freezing to the boiling point there are 100 degrees.

Rene Antoine Ferchault de Reaumur introduced, in 1730, the thermometer which bears his name. It is used in Russia, Sweden, Turkey and Egypt. 0 degrees or zero, corresponds to melting ice, 80 degrees to boiling water. From the freezing to the boiling point there are 80 degrees.

Each degree of Fahrenheit is 5/9 of a degree Centigrade, and 4/9 of a degree Reaumur. The Centigrade temperature interval between the freezing and the boiling point being 100 and the Fahrenheit interval 180, it follows that 1 degree Centigrade is equal to 1.8 degrees Fahrenheit.

Centigrade temperatures are converted into Fahrenheit's scale by multiplying the former by 9 and dividing by 5, and adding 32 degrees to the quotient; and conversely, Fahrenheit temperatures are converted into Centigrade scale by deducting 32 and taking 5/9 of the remainder.

Example:

Centigrade Degrees— $20 \times \frac{9}{5} = 36$ and
 $36 + 32 = 68$ degrees F.

Fahrenheit Degrees: $68 - 32 = 36$ and
 $36 \times \frac{5}{9} = 20$ degrees C.



COMMENTS AND QUERIES

An Amateur

It has afforded the writer the greatest pleasure, and he has read with the keenest interest, *THE AQUARIUM* for the month of February, kindly sent him by a friend who was acquainted with his weakness in the matter of goldfish and their breeding. One is apt sometimes to think, especially when somewhat isolated, that they are the only ones following a certain line of study, and it is always a delightful experience to find that there are others who have made the same field an object of investigation. The information gleaned from the pages of *THE AQUARIUM* are not only interesting and instructive, but exceedingly fascinating to the mind of one engaged in such matters. The goldfish, however, has been the only fish that has been studied by the writer, and most of the little knowledge attained has been by close observation of their habits. The first really instructive matter read upon this subject has been in your magazine, with the exception of a few items which were of little value, in some papers. There were years of stumbling in the dark, and, of course, there is much to be learned and attained to yet. The proper balancing of an aquarium, both with vegetable and animal life, has afforded great pleasure, and to produce the proper conditions for the healthful state of the fish has been a source of ever increasing interest. However, it is delightful to learn that all that has been so laboriously studied out has been en-

tered upon in a scientific way, and it is therefore to be supposed that the secrets held by the Japanese and Chinese in the culture of these fish, will before long be fully understood. The construction of small ponds for the raising of these fish and aquatic plants was a field entered upon by the writer without much information or matter to study from, but still, many who have seen these aquariums in their beauty in the Summer at his place, have gone away and started up ponds for themselves, with varying success. Water gradening and fish culture, are both, not only interesting and instructive, but afford pleasures not to be found in other kinds of gardening. There has been a great fascination in finding out these things, and now still another field has been opened up in the care of tropical and other fish, which he will hope to follow up. He will, however, despair of going into the matter in the scientific manner in which some of the writers to *THE AQUARIUM* have attained, but may look on and by studying these pages, perhaps obtain a better understanding of things aquatic.

CHAS. N. TRIVESS.

Do You Know?

CHICAGO LOCAL EDITOR.

For all practical purposes, it is sufficiently accurate to say that:

1 Cubic inch of water weighs	0.36 lbs
1 " foot " " "	62.5 "
1 U.S. gallon " " "	8.33 "
1 cubic foot of water equals	7.48 U.S. gals.
1 U. S. Gal. of water equals	231 cu. inches.
1728 cu. inches equal	1 cubic foot.

The pressure produced by a column of water is called the "static head." A head or column (or depth) of water 1 foot high, produces a pressure of 0.433 pound per square inch, or approximately 1 pound of pressure per every square inch to 28 inches of height or depth.

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Regular meetings 2nd & 4th
Tues. in every month except
July & Aug. at Fairchild Bldg.
702 Fulton St., at 8 P. M.
Initiation Fee, \$1.00
Annual Dues, \$2.00

Chicago Fish Fanciers' Club

Regular meetings on the
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127-139 North Clark St., at
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The Aquarium Society

Regular meetings on the
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German-American School,
Sherman Ave., Jersey City,
and on the Fourth Friday
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Natural History, 77th St.
and Central Park West, New
York, each month except
July and August. Corre-
sponding membership, \$1.00
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Philadelphia Aquarium Society

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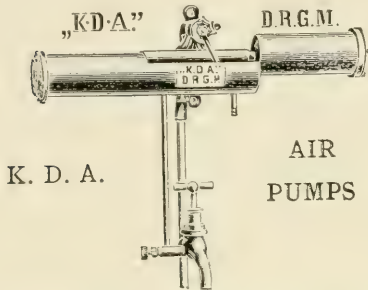
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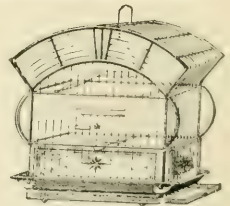
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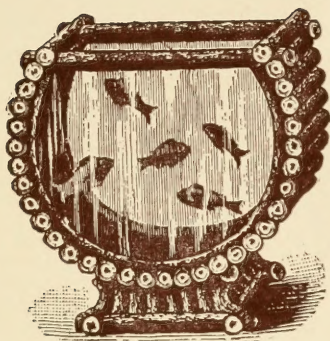
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